

before or after the resin injection is completed, opening the mold until the volume of its cavity is equal to that of the final molded product.

^{13.}
~~25.~~ (New) The molded product of Claim 23, which has a bending strength of not less than 80 MPa.

^{14.}
~~26.~~ (New) The molded product of Claim 23, which is molded into the shape of an automobile part, a component of an electric appliance, furniture or building material.

^{15.}
~~27.~~ (New) The molded product of Claim 23, wherein said thermoplastic resin is a resin selected from the group consisting of a polyolefin resin, a polystyrene resin, a polyvinyl chloride resin, a polyamide resin, a polyester resin, a polyacetal resin, a polycarbonate resin, a polyaromatic ether, a polyaromatic thioether, a polyaromatic ester resin, a polysulfone resin and a polyacrylate resin.

^{16.}
~~28.~~ (New) The molded product of Claim ¹²~~24~~, which has a bending strength of not less than 80 MPa.

^{17.}
~~29.~~ (New) The molded product of Claim ¹²~~24~~, which is molded into the shape of an automobile part, a component of an electric appliance, furniture or building material.

^{18.}
~~30.~~ (New) The molded product of Claim ¹²~~24~~, wherein said thermoplastic resin is a resin selected from the group consisting of a polyolefin resin, a polystyrene resin, a polyvinyl chloride resin, a polyamide resin, a polyester resin, a polyacetal resin, a polycarbonate resin, a polyaromatic ether, a polyaromatic thioether, a polyaromatic ester resin, a polysulfone resin and a polyacrylate resin.

REMARKS

Claim 12 has been canceled. Claims 13-22 and new Claims 23-30 remain active in the present case.

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The present invention relates to a method of preparing a light-weight, fiber-reinforced thermoplastic resin product and to a light-weight molded product.

As now broadly defined, the invention is directed to a molded, light-weight fiber-reinforced thermoplastic resin product having a fiber content ranging from 5 to 80% by weight and a porosity ranging from 10 to 80%, and having a skin layer with no voids on its surface, the fibers existing in the product having a weight-average fiber length ranging from 1 to 20 mm, wherein the thermoplastic resin is a polypropylene-based resin containing a polyolefin-based resin modified by the presence of an acid.

CLAIM REJECTION, 35 U.S.C. §112, SECOND PARAGRAPH

As to the matter raised by the Examiner concerning the meaning of "an acid-modified polyolefin-based resin", Applicants submit that the issue has been resolved by the amendment to Claim 13 which specifies that the thermoplastic resin is a polypropylene-based resin containing a polyolefin-resin modified by the addition (presence of) of an acid thereto. Thus, such a resin is prepared, for example, by blending acrylic acid, modified polyethylene with polypropylene. Moreover, as to the query concerning the "modification step", acid modification in fact means adding acid to the polyolefin-based resin as described in the specification at page 13, line 16 or line 20. Accordingly, the issue raised under 35 U.S.C. §112 is believed obviated, and withdrawal of the same is respectfully requested.

PRIOR ART REJECTION

Claims 16-22 stand rejected based on 35 U.S.C. §102(b) or 35 U.S.C. §103(a) as anticipated by or rendered obvious over Shaw et al. This ground of rejection is respectfully traversed.

As to the matter of the anticipatory ground of rejection, Applicants point out that the Shaw et al reference, in disclosing a process for preparing a low density, fiber-reinforced resin composite, describes heating of a densified fiber-reinforced resin sheet above its softening temperature whereby the sheet expands in the direction perpendicular to the plane defined by the sheet, and then the expanded sheet is cooled below the softening temperature thereof to form a low-density fiber-reinforced resin composite. The resin sheet therefore is used as a starting material. Accordingly, since the reference discloses a resin sheet, it therefore does not disclose an injection-molded product, and therefore the anticipatory ground of rejection is obviated.

As to the question of obviousness, Applicants emphasize that a most significant feature of the injection-molded product of the present application is that the surface of the object is very smooth and has no voids. This characteristic results from the present process features which are characterized by the step of injecting the molten resin into the cavity of a mold so closed that the volume of its cavity is smaller than the volume of the final molded product, and before or after injection of the resin is completed, the mold is opened until the volume of its cavity is equal to that of the final molded product. That is, in the step of injecting the molten resin into the cavity of a mold so closed that the volume of its cavity is less than that of the final molded product, initially the molten resin reaches the surface of the mold and is cooled which results in a very smooth surface skin layer as in ordinary injection molding.

Now as to the resin sheet disclosed in Shaw et al, the same is produced by a process in which initially the densified sheet is heated above the softening temperature of the resin sheet in the absence of pressure which prevents expansion of the sheet (column 4, lines 59-65). In this first step of the process, the bent fibers in the densified sheet straighten as a

result of the melting of the matrix resin. This aids in the lofting of and expansion of the sheet (column 3, lines 13-15). A low density composite results which has a slightly rough surface which is attributable to the presence of the reinforced fibers at the surface of the composite (column 6, lines 20-22). Furthermore, an advantage of the procedure disclosed in Shaw et al is that when the composite is adhered to a substrate by means of an adhesive layer, the bond between the composite and the adhesive layer is surprisingly tenacious because of the presence of the reinforced fibers at the surface of the expanded low-density composite (column 7, lines 21-23 and 27-29).

Applicants note that the Examiner has stated that "the composite is said to be characterized by surfaces being a smooth resin layer from about 0.05 to 1 mil thick". This statement apparently is based on the description in the reference that "such layers are provided by performing the heating and cooling steps between two surfaces spaced such that the expanded composite completely fills the area between the surfaces" (column 6, lines 25-29). However, even in this case, the same mechanism as described above is applied. That is, first of all the bent fibers in the densified sheet straighten upon the melting of the matrix resin, and then reach the upper surface earlier than the molten resin. Accordingly, the surface which results in the product sheet cannot be smooth as the surface of an ordinary injection molded product because of the presence of these fibers at the surface of the resin object. That this, in fact, is the case can be ascertained from the expression used in the specification of the patent of "a relatively smooth resin layer", which would mitigate against the interpretation given by the Examiner to the term "smooth" as being descriptive of the present invention. Clearly, the injection molded product of the present invention is fundamentally different from the resin sheet disclosed by Shaw et al which is produced by the free

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expansion of the densified sheet containing fibers. Accordingly, the obviousness ground of rejection is believed overcome, and withdrawal of same is respectfully requested.

As to the matter of the incorporation of the term "injection" molding into the present claims, Applicants point out that support for the same can be found, for instance, on page 4. Further, support for new Claims 23 and 24 can be found in the claims of record and the process claims originally presented of record in this case. As to newly presented Claims 25-30, support for the same can be found in Claims 14-16. Accordingly, entry of the amendment into the record is respectfully requested.

It is now believed that the application is in proper condition for allowance. Early notice to this effect is earnestly solicited.

Respectfully submitted,

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IN THE CLAIMS

--13. (Amended) An injection [A] molded, light-weight, fiber-reinforced thermoplastic resin product having a fiber content ranging from 5 to 80% by weight and a porosity ranging from 10 to 80%, and having a skin layer with no voids on its surface, the fibers existing in the product having a weight-average fiber length ranging from 1 to 20 mm, wherein the thermoplastic resin is a polypropylene-based resin containing a [an acid-modified] polyolefin-based resin modified by the addition of acid.

14. (Amended) The injection molded product of Claim 13, which has a bending strength of not less than 80 Mpa.

15. (Amended) The injection molded product of Claim 13, which is molded into the shape of an automobile part, a component of an electric appliance, furniture or building materials.

16. (Amended) [A] An injection molded, light-weight, fiber-reinforced thermoplastic resin product having a relative bending strength of not less than 80 MPa, wherein the resin is selected from the group consisting of a polyolefin resin, a polystyrene resin, a polyvinylchloride resin, a polyamide resin, a polyester resin, a polyacetal resin, a polycarbonate resin, a polyaromatic ether, a polyaromatic thioether, a polyaromatic ester resin, a polysulfone resin and a polyacrylate resin, having a fiber content [of] ranging from 5 to 80% by weight and a porosity [of] ranging from 10 to 80%, and having a skin layer with

no voids on its surface, the fibers existing in the product having a weight average fiber length [of] ranging from 1 to 20 mm.

17. (Amended) The injection molded product of Claim 16, which has a bending strength of not less than 90 Mpa.

18. (Amended) The injection molded product of Claim 17, which has a bending strength of not less than 100 Mpa.

19. (Amended) The injection molded product of Claim 16, wherein the content of fibers ranges from 10 to 70% by weight.

20. (Amended) The injection molded product of Claim 16, wherein the porosity of the product ranges from 20 to 70% by weight.

21. (Amended) The injection molded product of Claim 16, wherein the fibers have a weight-average fiber length of 1.5 to 15 mm.

22. (Amended) The injection molded product of Claim 16, which is molded into the shape of an automobile part, a component of an electric appliance, furniture or building materials.

23. (New)

24. (New)

25. (New)

26. (New)

27. (New)

28. (New)

29. (New)

30. (New)--